Isolated Hemothorax Following Thoracic Trauma: Analysis of 57 Cases

Toraks Travmasına Bağlı İzole Hemotoraks: 57 Olgunun Analizi

İzole Hemotoraks / Isolated Hemothorax

Ufuk Çobanoğlu[1], Mehmet Melek[2], Volkan Kara[3], Duygu Mergan[1]
[1]Department of Thoracic Surgery, School of Medicine, Yüzüncü Yıl University, Van, [2]Department of Pediatric Surgery, School of Medicine, Yüzüncü Yıl University, Van, [3]Gumushane State Hospital,Clinic of Thoracic Surgery, Gumushane, Turkey

Özet

Amaç: Bu çalışmada toraks sonrası ortaya çıkan izole hemotoraks vakaları incelendi. Bu şekilde izole hemotoraks olgularında tanı ve tedavi metodları tartışıldı, mortalite ve mordite üzerinde etkili faktörler tartışıldı. Gereç ve Yöntem: Toplam 57 hasta ve bilgiler retrospektif olarak incelendi. Tüm hastalara ilk tedavi yaklaşımı olarak tüp torakostomi ve kapalı sualtı drenajı uygulandı. Acil torakotomi göğüs tüpünden devam eden drenaj, postero anterior akciğer grafisinde sebat eden hemotoraks görünümü ve hemodinamik olarak stabil olmayan hastalarda uygulandı. Bulgular: Hemotoraks 31 hastada (%54.38) delici ya da kesici yaralanmaya, 26 hastada (%45.61) künt travmaya bağlı olarak ortaya çıkmıştı. Hastaların 49'una (% 85.96) başvurusunda tüp torakostomi ve kapalı sualtı drenajı uygulandı. Tüm hastaların 8'inde (%14.03) delici kesici yaralanmaya bağlı ortaya çıkan hemotoraks için torakotomi uygulandı. Künt travmalı hastaların morbiditesi delici yaralanma geçirenlere oranla belirgin olarak yüksek bulunmuşdu (p<0.0001). Sonuç: Travmatik hemotorakslı hastalarda doğru tanı ve uygun cerrahi işlem yapılması morbidite ve mortaliteyi azaltmak için gereklidir. Hastalarda göğüs tüpü ve kapalı sualtı drenajı sistemi ilk uygulanması gereken tedavidir. Bu tedavi birçok hasta için başarılı sonuçlar oluşturmaktadır. Acil torakotomi endikasyonlu hastalarda hayat kurtarıcıdır. Delici göğüs travmalarına bağlı izole hemotoraksta torakotomi ihtiyacı daha sıktır.

Anahtar Kelimeler

Travma; İzole Hemotoraks; Göğüs Tüpü; Tedavi

Abstract

Aim: The aim of this study was to review cases with isolated hemothorax after thoracic trauma, to assess the diagnostic and treatment methods, and to discuss the determining factors of morbidity and mortality. Material and Method: A total of 57 patients were examined retrospectively. All patients underwent tube thoracostomy and underwater seal as the initial treatment approach. Emergency thoracotomy was performed on cases with continuing drainage from the chest tube, expanding hemothorax on the posteroanterior (PA) chest x-ray, and with hemodynamic instability. Result: Hemothorax occurred as a result of penetrating trauma in 31 (54.38%) and due to blunt trauma in 26 (45.61%) cases. Of the cases, 49 (85.96%) underwent tube thoracostomy drainage. All the 8 cases (14.03%) that underwent emergency thoracotomy had penetrating trauma. Mortality occurred in one patient (1.75%) who had penetrating trauma and who underwent emergency thoracotomy. The morbidity rate in patients with blunt trauma was significantly higher than those with penetrating trauma (p<0.0001). Discussion: Accurate diagnosis and appropriate surgical intervention in cases with traumatic hemothorax is essential for reducing the morbidity and mortality. Chest tube insertion and underwater seal application should be the initial treatment modality and successful in most cases. Emergency thoracotomy is life-saving in indicated patients. The need for thoracotomy is higher in isolated hemothorax due to penetrating chest trauma.

Keywords

Trauma; Isolated Hemothorax; Chest Tube; Treatment

DOI: 10.4328/JCAM.520 Received: 06.12.2011 Accepted: 22.12.2010 Printed: 01.01.2012 J Clin Anal Med 2012;3(1):41-5
Corresponding Author: Ufuk Çobanoğlu, Yüzüncü Yıl Üniversitesi Tıp Fakültesi Göğüs Cerrahisi AD. Van, Türkiye.
T.: +90432 215 0473 F.:+90432 2168352 E-Mail: drucobanoglu@hotmail.com

Introduction

Thoracic traumas are well-known in medical history since ancient times. Hippocrates and Galen reported the principles of treatment in blunt and penetrating thoracic traumas in detail [1].

Despite major developments in the management of trauma, it remains the leading cause of mortality in children and adults. Motor vehicle accidents are the main cause of blunt injury, whereas gunshots with bullets of low acceleration and stab-wounds are the main causes of penetrating injuries [2,3].

Hemothorax and/or pneumothorax are the most common pathologies in thoracic trauma, regardless of etiology. Post-traumatic hemothorax is a consequence of parenchymal injury, injuries of intercostal vessel, chest wall, bronchial artery and/or that of the major thoracic vessels and the heart [1-3]. Prompt diagnosis and treatment are vital in traumatic hemothorax. Short delays may also lead to death [4].

The aim of this study was to review cases with isolated hemothorax after thoracic trauma, to assess the diagnostic and treatment methods, and to discuss the determining factors of morbidity and mortality.

Material and Method

A total of 57 patients presented to our hospital between September 2004 and April 2007, 7 of the patients were chidren age ranging between 11 to 15 years old .Medical records of the patients were examined retrospectively. They all had the diagnosis of isolated hemothorax without associated extra-thoracic and intra-thoracic organ injury.

The patients' age, gender, time of admission, physical examination findings, treatment modalities, the duration of chest tube remaining in patients had chest tube insertion and the duration of hospitalization were assessed. The patients had diagnosis by using posteroanterior (PA) and lateral chest x-rays, ultrasonography (USG) of thorax, computerized tomography (CT) of thorax, and thoracentesis. Routine complete blood counts (CBC) and biochemistry tests were performed. The patients were followed by PA chest X-rays, amount of drainage from the chest tube, routine CBC and biochemistry tests also vital parameters.

All patients underwent chest tube insertion as the initial treatment approach. Chest tubes sized from 24 to 36 F (french) were used. They were placed surgically at the point of intersection of the fifth or sixth intercostal space at the mid- or posterior axillary lines. The indications of emergency thoracotomy were: >1000 ml (>20 ml/kg) of hemorrhagic drainage from the chest tube after the insertion, >200 ml/hour (>2 ml/kg/hour) of hemorrhagic drainage in the first 2-4 hours in the follow-up, >100 ml/hour hemorrhagic drainage in the first 6-8 hours, an enlarged view of hemothorax on the PA chest x-ray, decreasing blood pressure and hemodynamic instability despite volume replacement and continuing hemorrhagic drainage from the chest tube. Patients who needed to undergo thoracotomy had postoperative and follow-up complications were recorded. None of the patients had accompanying pneumothorax and associated extra-thoracic organ injury.

The statistical difference between gender and type of thoracic trauma was analyzed using the Pearson Chi-square test and the statistical difference between blunt and penetrating trauma and the rates of morbidity and mortality was assessed using the Chi-square test. The level of significance was set as $p<0.05$.

Result

The mean age was 39.08±16.66 years. The age range was 11-71 years. Of the cases, 44 (77.20%) were male and 13 (22.80%) were female. There were 7 (12.28%) children of whom 5 were male and 2 were female with an age range of 11-15 years. The female/male ratio in the children was 1/3.5. Hemothorax occurred as a result of penetrating trauma in 31 (54.38%) and due to blunt trauma in 26 (45.61%) cases. Of the cases with penetrating trauma, 4 (12.90%) were female and of the cases with blunt trauma, 9 (34.61%) were female. Of the penetrating traumas, 24 (77.41%) were caused by stab-wounds and 7 (22.58%) by gunshots. In a 15-year-old patient, the thoracic trauma was caused by penetrating trauma due to stab-wounds (Table 1). The most common cause of hemothorax with blunt traumas was motor vehicle accidents (53.84%) (Figure 1).

The statistical difference between gender and type of thoracic trauma was analyzed using the Pearson chi-square test and it was found that blunt traumas were significantly more common than penetrating traumas in females (p=0,037).

Blunt and chest preponderant traumas were more common in the summer times (47.36%) (Table 2).

The time range of hospital admissions was from 30 minutes to 14 days after the trauma. Of the cases, 9 (15.78%) had presented to the hospital within the first hour, 13 (22.80%) within 1-3 hours, 28 (49.12%) within 3-5 hours, and 7 (12.28%) >5 hours after the trauma.

The trauma was on the right-side in 28 cases (49.12%), on the left-side in 20 cases (35.08%), and it was bilateral in 9 cases (15.78%).

Two cases (3.50%) who had clotted hemothorax due to blunt thoracic trauma and who had a delayed admission to hospital (10-14 days), they both underwent hematoma evacuation with VATS (Video Assisted Thoracoscopic Surgery), and furthermore, one needed decortication of the effected lung afterwards.

Eight cases (14.03%) with hemothorax after penetrating trauma underwent emergency thoracotomy (Table 1). In 5 (8.77%) patients, there were filiform pulse character, tachycardia, systolic blood pressure of ≤50 mmHg as symptoms of shock, and defibrinated blood were aspirated by thoracentesis, these patients had emergency thoracotomy without waiting for the

Table 1. Characteristics of our cases with penetrating trauma and the surgical treatment methods

Case	Age	Gender	Type of trauma	Cause of hemothorax	Operation
1	21	M	Gunshot wound	Right ventricle laceration + interlobar artery laceration + massive parenchyma laceration	Evacuation of thorax hematoma + primary repair of myocardium + lobectomy
2	35	F	Stab-wound	Intercostal artery laceration	Evacuation of thorax hematoma + intercostal artery ligation
3	46	M	Stab-wound	Intercostal artery laceration	Evacuation of thorax hematoma + intercostal artery ligation
4	19	M	Stab-wound	Mammarian artery laceration	Evacuation of thorax hematoma + mammarian artery ligation
5	24	F	Stab-wound	Mammarian artery laceration	Evacuation of thorax hematoma + mammarian artery ligation
6	51	M	Gunshot wound	Right atrium laceration	Evacuation of thorax hematoma + primary repair of myocardium
7	15	M	Stab-wound	Intercostal artery laceration	Evacuation of thorax hematoma + intercostal artery ligation
8	35	M	Stab-wound	Intercostal artery laceration	Evacuation of thorax hematoma + intercostal artery ligation

Figure 1. The causes of trauma in cases with isolated traumatic hemothorax

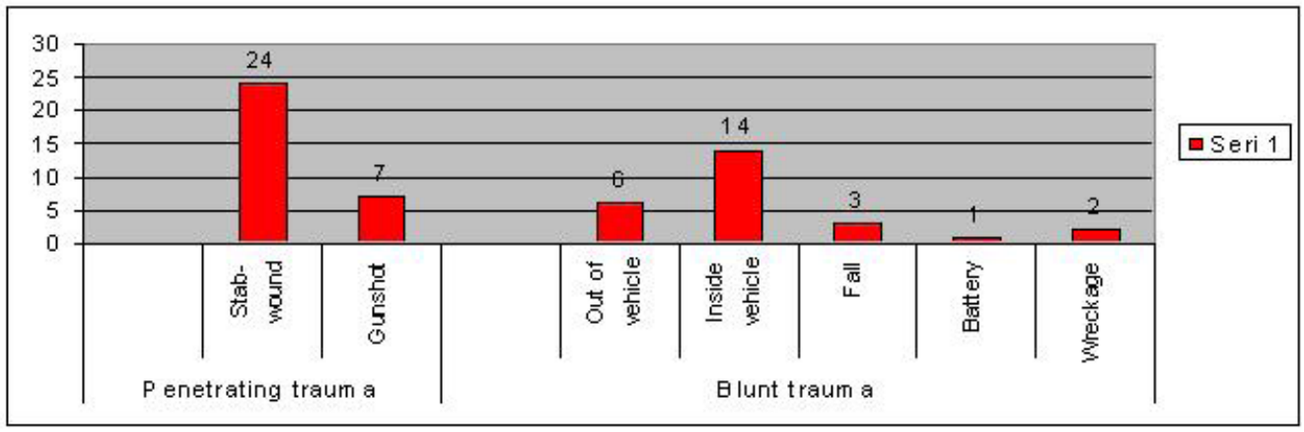

Table 2. The month in which the trauma occurred in cases with hemothorax

Type of trauma	**Months**			
	December-February	*March-May*	*June-August*	*September-November*
Penetrating Traumas				
Stab wound	4	5	9	6
Gunshot wound	1	2	4	-
Blunt Traumas				
Motor vehicle	1	2	13	4
Fall		1	1	1
Battery		1		
Getting caved in	1			1
Total	*7*	*11*	*27*	*12*

radiological investigation. In these 5 patients, there were 2500-3500ml of on average of fresh and clotted blood was found in the thoracic cavity of the injured side. The other three (5.26%) patients had >1000 ml and/or >200 ml/4 hours drainage in the first drainage after insertion of the chest tube and had hemodynamic instability.

Of the cases, 49 (85.96%) underwent chest tube drainage and underwater seal application. The mean duration of chest tube remaining in situ was 5.17±1.61 days; the mean duration of hospitalization was 9.26±1.74 days. The mean amount of drainage in all cases was 1011.6±37.0 ml and the mean amount of transfused blood was 1.2±09 units.

Postoperative empyema was seen in two patients (5.26%). One patient (1.75%) who had cardiac and pulmonary vascular injury and who had presented nine hours after the event was operated immediately, but was lost due to development of Acute Respiratory Distress Syndrome (ARDS) in the early postoperative period. The laseration involving the heart was diagnosed during the operation and surgical repair to the heart tissue was perfomed.

The statistical difference between blunt and penetrating trauma and the rates of morbidity were analyzed using the Chi-square test. It was found that the morbidity rate was significantly higher in blunt traumas ($p<0.0001$). Although it was found that the mortality rate was higher in penetrating traumas, this was not significant ($p=0.157$).

Discussion

The leading cause of death in individuals <40 years of age is trauma-related injury and 20-25% of these deaths are due to chest injuries [5]. Mortality arising from injury to the chest alone has been estimated at 4-12% and increases with injury to other organ systems. The lung is the most commonly injured intrathoracic structure [6]. Isolated thoracic trauma is not common in blunt traumas. Associated extra-thoracic injuries are seen in 75% of thoracic traumas [7]. Thus, the diagnosis and treatment of a case with hemothorax is a challenge, requiring swiftness and a multidisciplinary approach [4].

Hemothorax is the presence of blood in the pleural space. The source of blood may be the chest wall, lung parenchyme, the heart, or the great blood vessels. Hemorrhagic shock and respiratory failure can occur due to blood in the pleural space [8]. The clinical importance of hemothorax depends on the amount, speed, and etiology of hemorrhage into the intrapleural space, on the presence of accompanying lesions such as pneumothorax, and on the chronicity [4].

The rates of blunt and penetrating thorax trauma were found to be 78.9% and 21.1%, respectively, in the MTOS (The Major Trauma Outcome Study) [9], whereas this was reported as 57.9% by Yalcinkaya et al. [3]. Our rates were higher for penetrating trauma (54.38%) and blunt trauma (45.61%). This may be due to enrolling only the cases with isolated hemothorax and excluding the cases with thoracic trauma with accompanying intra-thoracic and extra-thoracic organ injuries.

Chest trauma is most commonly seen in males in the second to fifth decades of life [3,5]. The majority of our cases were males (77.20%), and consistent with these data, the mean age of all patients was 39.08±16.66 years. These results suggest that individuals in these decades are more active and males have a more active social role than females in our region. According to the data in our study, in females, the rate of blunt trauma was higher than that of penetrating traumas compared to males ($p=0.037$).

Trauma remains the leading cause of death in children aged 1

to 14 years [10]. Thoracic trauma is relatively frequent in children and causes considerable mortality. This is mainly due to the multi-organ nature of trauma [11]. The most common etiology of hemothorax in children is trauma [8]. Blunt trauma is the most frequent cause of chest injuries in children [6,8,10].

In children, hemothorax usually occurs as a consequence of blunt or penetrating trauma, with penetrating trauma being more severe than blunt trauma [8]. In our study, only one of the 7 children had hemothorax due to penetrating chest trauma with a stab-wound. Hemothorax had occurred due to blunt trauma in six children.

Thoracic injury among children hospitalized for blunt and penetrating trauma ranges from 4% to 6% (10,12). Ceran et al. [12] reported that of 1653 patients treated for thoracic trauma, 225 patients (13.6%) were children. The female/male ratio was 1/7.5. In our cases, 12.28% were children with a female/male ratio of 1/3.5 (2 females, 5 males).

Thoracic trauma in children deserves particular attention; it causes more fatalities than injuries to other systems. The thorax of children is extremely compliant, because the ribs are elastic allowing direct transfer of energy to the underlying lung. This is the reason for high-energy trauma to the chest causing twice as many lung contusions in children than in adults [11,13]. The ratio of blood volume/body weight in children is higher than that in adults. Therefore, very little bleeding may lead to hypovolemia and shock [12]. The pericardial sac of a child has a small volume, and a volume of 200 ml of blood is necessary to cause significant tamponade in young children [6]. The majority of chest injuries can be managed by immediate drainage with a wide calibrated chest tube in an unstable child and can be life-saving [10,12].

Many children with thoracic trauma exhibit a wet lung, a syndrome characterized by a combination of pulmonary contusion, atelectasis and pneumonia. Awareness of these serious complications is in itself the best treatment [6]. We had three children suffering from this condition. None of these cases developed the complication of wet lung syndrome since we administered antibiotics, corticosteroids and pulmonary rehabilitation.

Although stab-wounds and gunshots are considered as a model of adult behavior, the incidence is increasing at an alarming rate in adolescent males [6,14]. In our study, in a 15-year-old male patient, a laceration of the intercostal artery due to a stab-wound was successfully treated with evacuation of the hematoma and ligation of the intercostal artery (Table 2).

We observed that the majority of chest traumas (47.36%) occurred in the summer times (Table 1). This may be related to restricted social mobility in winter due to the harsh weather conditions in our region. The travelling population and traffic load so the incidence of traffic accidents, falls from roofs while sleeping both increase during the summer time. Also increased rates of falls from trees while collecting walnuts, and increased social participations in the summer.

The majority of chest injuries can be followed-up safely closely without any intervention. Some patients may require only chest tube insertion with underwater seal system without any additional surgical intervention [11,12,15]. Following thoracic trauma, if the patient with hemothorax has a concomitant pneumothorax, or has increasing amount of hemothorax or deteriorating general status, immediate chest tube insertion connected to under water drainage system should be performed.

Chest tube application is a surgical procedure so that should be performed in sterile conditions. Insertion point of tube to thoracic cavity is where the sixth or the seventh intercostal space intersects the posterior axillary line (i.e. from the lowest level of intrapleural space).

In adults and children >12 years of age, a 36- 42 F chest tube is used, whereas a 24-34 F chest tube is used in children <12 years of age to settle an adequate drainage. After insertion of the chest tube, its localization is confirmed by re-performing the PA chest x-ray. If there is adequate drainage and the bleeding is under control shows that the treatment is sufficient [4], which is the result in 60-90% of the patients [3-5,7]. In this study, 85.96% of our cases were treated only by chest tube insertion with an underwater seal. All cases requiring emergency thoracotomy were patients with penetrating trauma.

Efficient pain control, pulmonary rehabilitation and chest tube are usually sufficient in the treatment of chest trauma patients with hemothorax. The common approach in these situations is monitoring the patients with close follow-up of vital signs, and amount of drainage after insertion of the chest tube. Thoracotomy is performed when the patients' medical condition shows an indication [16]. Lung parenchymal injuries are usually treated with chest tube, whereas thoracotomy is generally required in hemothorax originating from intercostal vessels or arteria mammaria interna [4]. Having a massive drainage of 1000 ml or 100 ml/hour for more than 4 hours in acute cases shows an indication for emergency thoracotomy.

As the cause of hemothorax in blunt thoracic traumas is generally pulmonary parenchymal injury due to fractured tips of the costae, the number of cases requiring emergency thoracostomy is quite few. Emergency thoracotomy may be most frequently indicated in hemothorax cases due to stab wounds and gunshot injuries as it has been the case in our study. In gunshot injuries, an operative intervention is less indicated compared to stab wounds because of the cauterization effect of the bullet if there is no injury of the heart and the major vessel, and if there is no extensive chest wall defect due to high-accelerated guns.

Of the 8 cases, 5 (87.7%) patients with hemothorax developing after penetrating trauma immediately underwent emergency thoracotomy without having to wait for radiological investigations as they had filiform pulse, tachycardia, systolic blood pressure of <50 mmHg, shock symptoms and defibrinated blood in thoracentesis. The exploration finding in these cases was the detection of an average of 2500-3500 cc fresh and clotted blood. The cure rate was 80% in our patients in whom we performed direct, rapid thoracotomy only through clinical assessment and thoracentesis, and without having to wait for the radiological investigations. The other three (5.26%) patients had hemodynamic instability with >1500 ml of first time drainage and/or >200 ml in 4 hours after insertion of the chest tube. Our emergency thoracotomy rate (14.03%) was consistent with the literature [2,3,17].

In thoracotomy, the origin of hemothorax is found to be the heart, the aorta and branches, inferior and superior vena cava, pulmonary arteries, pulmonary veins, intercostal vessels, and the lungs [18]. Our patients' hemothorax were due to injuries of the heart, intercostal vessels and internal mammarian vessels, those patients were immediately operated and side of bleeding was diagnosed during operation (Table 2).

Drainage can be inadequate in hemothorax following thoracic trauma [4]. Inadequate evacuation of the hemothorax can lead to hematoma in the thorax and to the "trapped lung". In case of clotted hemothorax, effective drainage with chest tube should be maintained in the early period if bleeding stops. If not

drained, the hematoma may cause fibrothorax, this may be absorbed, or may cause empyema in some cases in the following time period [2]. In the group of patients with thoracic trauma, 5 to 30 percent of patients develop empyema [19]. The value of antibiotic prophylaxis for elective and emergency operations in surgical practice has been validated by many studies [20]. Chest tube insertion is necessary for the treatment of empyema, fibrothorax and chronic atelectasis due to residual hemothorax [21]. Early evacuation of hematoma significantly reduces the development of empyema and/or fibrothorax. The administration of intrapleural streptokinase or urokinase from the chest tube for enzymatic debridement of the pleural cavity for empyema and hemothorax has also been advocated [21].

Video-assisted thoracoscopy (VATS) provides another option for draining the hematoma; it should be performed in the first 7-10 days after trauma to reduce the risk of re-bleeding [22,23].

Meyer et al. [23] enrolled 39 patients with clotted hemothorax and whom were treated with VATS. They reported significant reductions in the duration of chest tube drainage, hospital stay after the procedure, overall hospitalization time and hospital costs; however, they suggested that it may not be efficient enough and therefore, may require additional surgical interventions and longer hospital stay [23]. Cansever et al. [2] reported that the timing of VATS was essential and that it would not be effective if delayed, resulting in pleural thickening.

We performed hematoma evacuation using VATS in two patients (3.5%) and additional decortication in one patient with clotted hemothorax due to blunt thoracic trauma with delayed admission to the hospital (9-14 days).

Our morbidity rate (3.50%) was similar to that in the literature and our mortality rate (1.75%) was lower [1-3,20]. This was considered to be related to performing emergency thoracentesis, defining the indication for thoracostomy, and performing surgery without having to wait for radiological investigations in hypotensive and shock-prone patients with thoracic trauma.

Despite the recommendation that the decision either for exploration or less invasive treatment should be made according to patient stability after chest tube insertion in patients with traumatic hemothorax, we concluded in this study that thoracentesis, in addition to physical examination findings, can be used as an effective diagnostic method to define the indication for thoracotomy without having to wait for radiological investigations in hypotensive and shock-prone patients with thoracic trauma.

Rapid and accurate assessment of cases with traumatic hemothorax is life saving. Most of the patients can be treated with tube chest tube. Thoracentesis is important in defining the indication for thoracotomy. We found that the most common cases requiring thoracotomy were those with penetrating hemothorax. VATS apporach with correct timing in suitable patients can be effective and beneficial.

References

1. Guitron J, Huffman LC, Howinton JA, LoCicero J. Blunt and penetrating injuries of the chest wall, pleura and lungs. In: Shields TW, LoCicero J, Reed CE, Feins RH, eds. General Thoracic Surgery. Seventh Edition. Philadelphia: Lippincott Williams& Wilkins, 2009;891-902.
2. Cansever L, Haciibrahimoglu G, Kutlu CA, Bedirhan MA. The clinical approach to the isolated traumatic hemothorax. National Journal of Trauma 2005;11:306-309 [in Turkish].
3. Yalcinkaya I, Sayir F, Kurnaz M, Cobanoglu U. Chest trauma: analysis of 126 cases. National Journal of Trauma 2000;6:288-291 [in Turkish].
4. Akay H. Diagnosis and treatment in hemothorax. Respiration 2002;4:195-205 [in Turkish].
5. Segers P, Van Schilp, Jorens Ph Van den Brande F. Thoracic trauma: an analysis of 187 patients. Acta Chir Belg 2001;101:277-282.
6. Al-Saigh A, Fazili FM, Allam AR. Chest trauma in children: A local experience. Ann Saudi Med 1999;19:106-109.
7. Galan G, Peñalver JC, París F, Caffarena JM Jr, Blasco E et al. Blunt chest injuries in 1696 patients. Eur J Cardiothorac Surg 1992;6:284-287.
8. Hayes D, Jr. Chest Pain. Clinical Pediatrics 2007;46:746-747.
9. Champion HR, Copes WS, Sacco WJ, Lawnick MM, Keast SL, Bain LW et al. The Major Trauma Outcome Study: Establishing national norms for trauma care. J Trauma. 1990;30:1356–1365.
10. Woosley CR, Mayes TC. The pediatric patient and thoracic trauma. Semin Thorac Cardiovasc Surg 2008;20:58-63.
11. Dahlem P, van Aalderen WMC, Bos AP. Pediatric acute lung injury. Paed Resp Rev 2007;8:348–362.
12. Ceran S, Sunam GS, Arıbas OK, Gormus N, Solak H. Chest trauma in children. European Journal of Cardio-Thoracic Surgery 2002;21:57-59.
13. Tsai FC, Chang YS, Lin PJ, Chang CH. Blunt trauma with flail chest and penetrating aortic injury. Eur J Cardiothorac Surg 1999;16:374-377.
14. Reinhorn M, Kaufman HL, Hirsch EF, Millham FH. Penetrating thoracic trauma in a pediatric population. Annals of Thoracic Surgery 1996;61:1501-1505.
15. Stafford PW, MacHarman C. Thoracic trauma in children. Curr Opin Pediatr 1993;5:325-332.
16. Yazkan R. Late term traumatic hemothorax: case report. Journal of Harran University Medical Faculty 2009;6:43-46 [in Turkish].
17. Leblebici HI, Kaya Y, Kocak AH. Analysis of 302 cases with thoracic trauma. Turkish Journal of Thoracic and Cardiovascular Surgery 2005;13:392-396 [in Turkish].
18. Kurnaz M, Cobanoglu U, Yalcinkaya I. Simultaneously Bilateral Thoracotomy Applied Two Cases With Hemothorax. Van Medical Journal 2004; 11:102-104 [in Turkish].
19. Eddy AC, Luna GK, Copass M. Empyma thoracic in patients undergoing emergent closed tube thoracostomy for thoracic trauma. Am J Surg 1989;157:494-497.
20. Luchette FA, Barrie PS, Oswanski MF, Spain DA, Mullins CD, Palumbo F et al. Practice Management Guidelines for Prophylactic Antibiotic Use in Tube Thoracostomy for Traumatic Hemopneumothorax: the EAST Practice Management Guidelines Work Group. Eastern Association for Trauma. J Trauma. 2000;48:753-757.
21. Inci I, Ozcelik C, Ulku R, Tuna A, Eren N. Intrapleural fibrinolytic treatment of traumatic clotted hemothorax. Chest 1998;114:160–165.
22. Lang-Lazdunski L, Mouroux J, Pons F, Grosdidier G, Martinod E, Elkaim D et al. Role of video thoracoscopy in chest trauma. Ann Thorac Surg 1997;63:327-333.
23. Meyer DM, Jessen ME, Wait MA, Estrera AS. Early evacuation of traumatic retained hemothoraces using thoracoscopy: a prospective, randomized trial. Ann Thorac Surg 1997;64:1396-1401.